



## Delaware Water Gap National Recreation Area

### INTRODUCTION



The Delaware Water Gap National Recreation Area is a 64.3-kilometer (40-mile) stretch of the middle Delaware River, bordering the states of New Jersey and Pennsylvania. The Delaware River is the largest free-flowing river in the eastern United States, one of the few remaining in North America. There are no dams to block this river as it winds between mountain ridges and down river valleys to the ocean. The Delaware River is in the center of a watershed that covers 21,789 square kilometers (13,539 square miles) of Delaware, New York, New Jersey, and Pennsylvania. The Delaware River originates in the Catskill Mountains of New York and flows into Delaware Bay between Delaware and New Jersey.



Courtesy of National Park Service

The Delaware Water Gap is known for the steep slopes and cliffs on either side of the river.

The Delaware Water Gap National Recreation Area has always attracted people with its beauty and natural resources. The earliest known inhabitants in this region, the Lenni-Lenape Indians, made their home here before the arrival of European settlers.

In early colonial times Dutch settlers mined the mountains for copper. The mountain ridges were sites for forts during the French-Indian War, and remnants of Revolutionary and Civil War cemeteries can still be found. Forty kilometers (25 miles) of the 3476-kilometer (2160-mile) Appalachian Trail runs along the ridge tops in the Delaware Water Gap National Recreation Area. In the late 19th century, the area was a popular resort and vacation area for tourists from Philadelphia and New York City. Later, the area was used in silent movies, and became the home of numerous family and youth summer camps.

The Delaware Water Gap National Recreation Area borders 64 kilometers (40 miles) of the Delaware River, and covers 28,000 hectares (69,000 acres) in New Jersey and Pennsylvania. This park was established on September 1, 1965, for public recreational activities, to preserve scenic and scientific resources, and to protect the area around the proposed Tocks Island Dam and Reservoir. In 1978, part of the Delaware Water Gap National Recreation Area was designated a National Wild and Scenic River. After years of planning and public opposition, plans for the controversial dam and reservoir were abandoned in 1992. The recreation area focuses on outdoor activities such as boating, fishing, canoeing, and swimming.

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|                      |
| Courtesy of National Park Service  |
| The Delaware Water Gap National Recreational Area is a popular spot for water sports, such as fishing. |

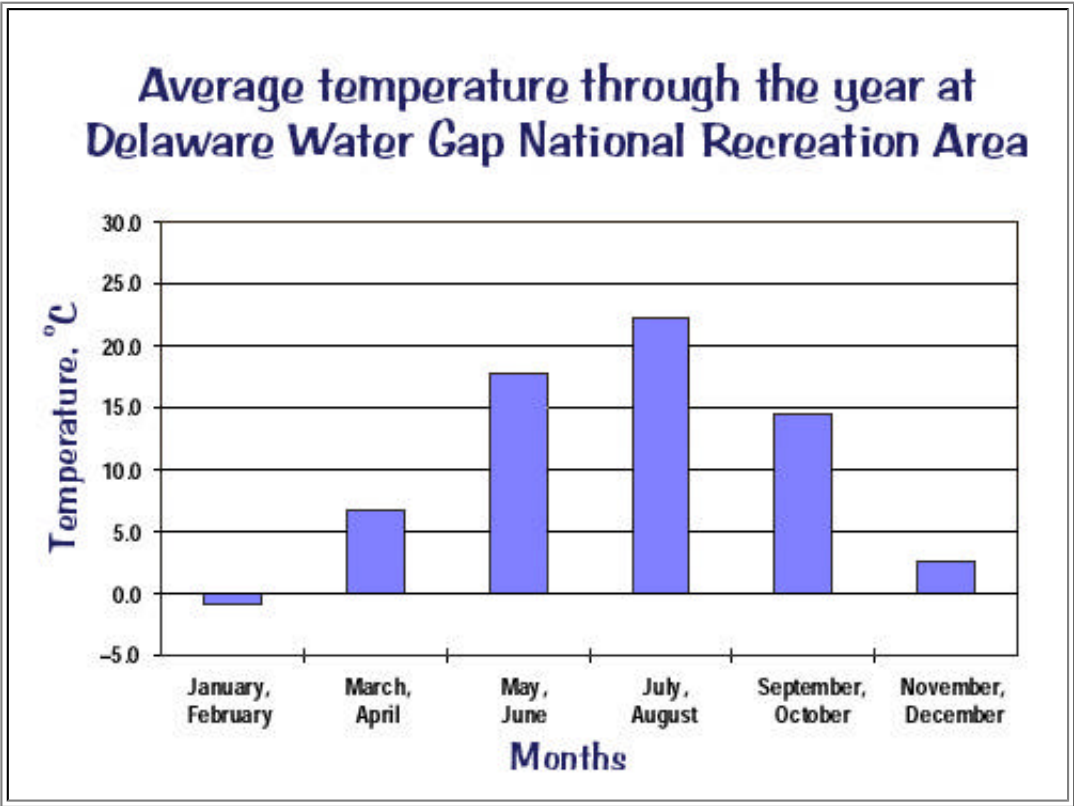
The Delaware Water Gap National Recreation Area is within a day's drive of 60 million people. In 1994, there were 4.37 million visitors to the Delaware Water Gap, compared to 3.4 million in Yellowstone National Park that same year.

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| Courtesy of National Park Service   | Courtesy of National Park Service  |
| Trails through riparian forest line the riverbanks.                                 | Small streams throughout the watershed feed into the Delaware River.                 |

The Delaware River is one of the cleanest rivers in the United States. The Delaware Water Gap National Recreation Area is an example of a [freshwater ecosystem](#). This aquatic ecosystem is bordered by a riparian (river) forest buffer. A riparian forest buffer is a band of trees, shrubs, and native vegetation that borders a stream or river. The buffer zone protects the waterway by trapping and filtering pollutants as the groundwater flows through the subsurface. Together, the river and the buffer zone make up the freshwater ecosystem.

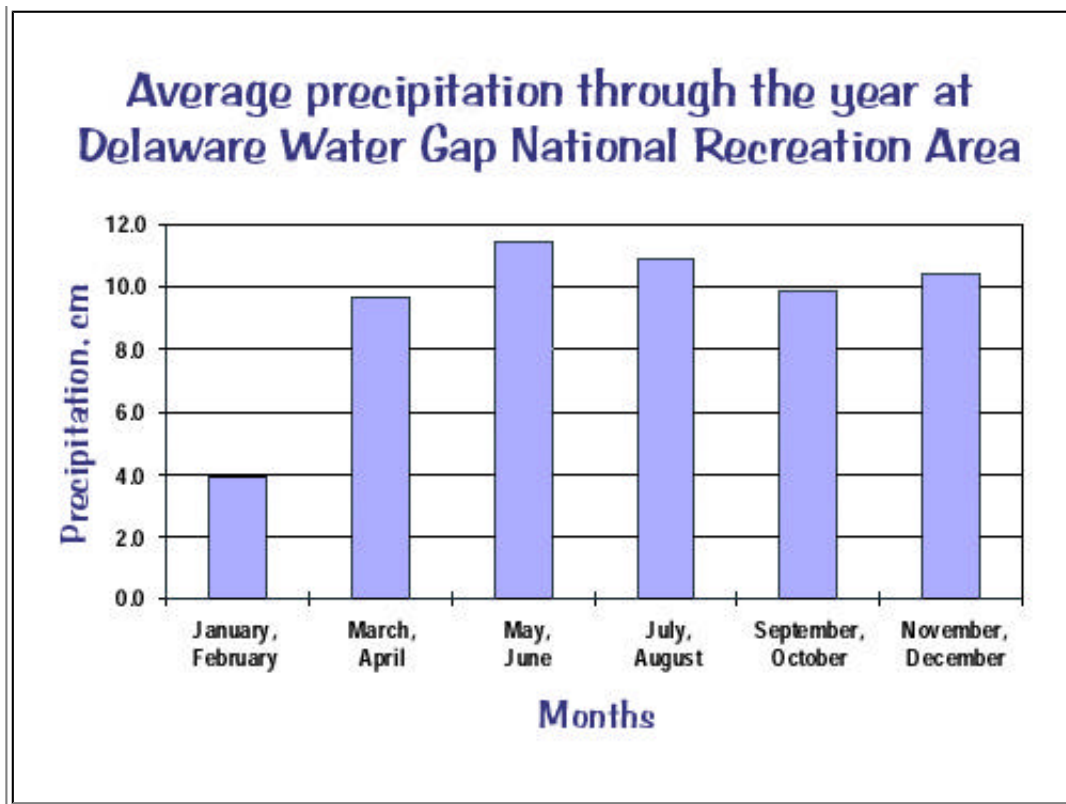
ABIOTIC DATA

Summers at Delaware Water Gap National Recreation Area are warm and humid, and winters are cold. Average summer air temperatures range between 17 and 23°C (62 and 73°F). Water temperatures are similar, but drop a few degrees as the water tumbles through ravines. Thunderstorms and dense fog are common in the summer. Sometimes large volumes of cold water flow down the river when excess water is released from Cannonsville Reservoir on the West Fork of the Delaware River in New York. This causes the water temperature in the Delaware River to drop.



The Delaware Water Gap has cold winters. Air temperatures range between -2°C and 2.5°C (28 and 36.5°F). Water temperature drops to freezing, and most of the river is covered in ice each winter. Snow and ice storms are common.





Mountain elevations in the Delaware Water Gap National Recreation Area range between 150 and 430 meters (500 and 1500 feet). Delaware River water depth is measured in Montague, New Jersey. Normally, the water is 1.5–2 meters (5–6 feet) deep, but during floods the water can reach 7.5 meters (25 feet) deep. Floods occur because of stormy weather or because water has been released from an upstream reservoir, like the Cannonsville Reservoir in New York.

The water in the Delaware Water Gap is generally smooth and quick-flowing. There are a few small rapids, but most of the river is a series of shallow riffles and quiet pools. The river substrate is pebbles and cobbles deposited by ancient glaciers.

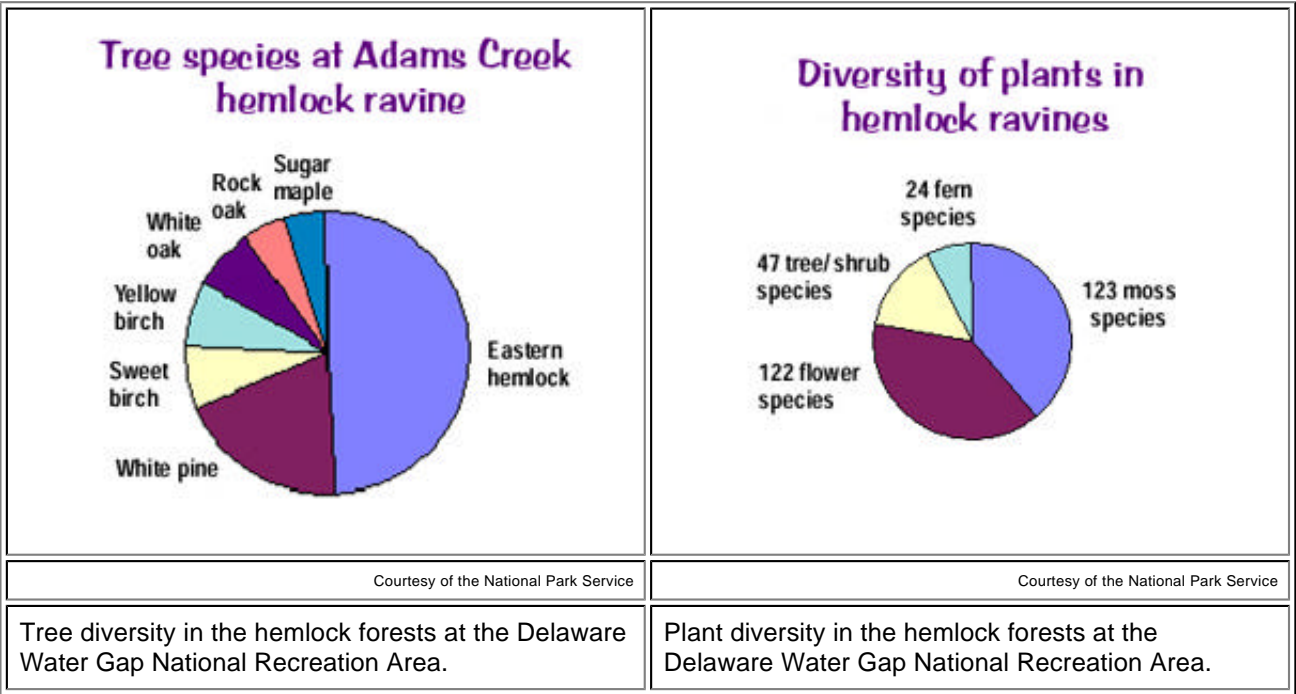
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## BIOTIC DATA

The river, streams, and ponds of the Delaware Water Gap are bordered by a riparian forest dominated by [eastern hemlock](#). The hemlock forest is intermingled with other species of trees, such as [white pine](#), [sugar maple](#), birch, and oak. This thick canopy of trees shades the water and helps produce the cool water temperatures and low light levels preferred by [brook trout](#). The hemlock trees are also important bird breeding habitat, especially for the [Blackburnian warbler](#), winter wren, and other songbirds. In June, [flame azaleas](#) burst into bloom and cover sunny hillsides. In summer, berry vines supplement the diet of [black bears](#) and [raccoons](#).

Along the banks of streams and calm pools, narrow-leaf cattails grow. They provide shelter and protection for many small animals. Near the water you might find amphibians like [slimy salamanders](#) and [American toads](#). Amphibians breathe through their skin, which must stay moist for this gas exchange to occur. In the pond shallows, [great blue herons](#) hunt, and [mallard ducks](#) dabble. [Northern water shrews](#) dive from the stream's edge into the water to look for insects and small fish.

[Beavers](#) haul logs from the surrounding forest to the water to build their lodges and dams. [Common map turtles](#) bask on the partially submerged logs of beaver dams and lodges. Some abandoned beaver lodges may be occupied by [minks](#) that forage along the riverbank.



The surface of a summer pond might be covered in small insects, [mayflies](#), each only 2.5 centimeters (1.0 inches) or less in length. Mayflies spend most of their lives as nymphs, clinging to underwater plants and eating [algae](#) and detritus. When they molt and emerge as adults, they live only a few hours or days. The mayflies floating on the water are the adults that have already mated and laid their eggs.

A closer look at the water and at the rocks in it reveals a film of [blue-green algae](#). These cyanobacteria are important producers in a freshwater ecosystem. Blue-green algae are very sensitive to changes in water nutrient levels. For instance, an increase in nitrogen can cause algae to grow rapidly. This is called an algal bloom. When the massive population of algae dies, the decomposition process can consume all the oxygen in the water. Such blooms decrease the amount of oxygen available to other organisms in the water.

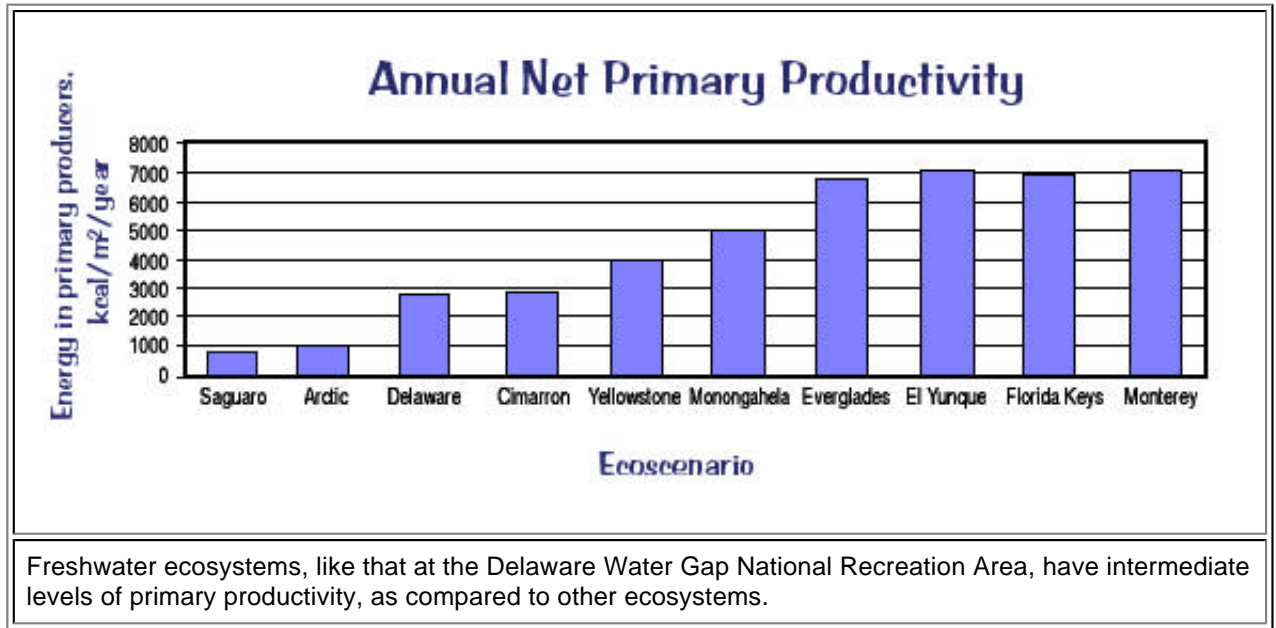


The rocks, vegetation, and mud of the stream bottom are covered with organisms. Tiny crustaceans called [scuds](#), only 5–20 mm (0.2–0.8 inches) long, swim through the vegetation. [Aquatic snails](#) scrape algae off submerged plant stems and rocks. [Freshwater mussels](#) live in the muddy stream bottom, and get their food by siphoning water and

mud and filtering out plankton, algae, and detritus. In the early summer, tiny black tadpoles, larvae of the [American toad](#), and other amphibians feed on plankton and algae. [Wolf spiders](#) lurk in the vegetation, waiting to capture another meal.

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| Courtesy of National Park Service   | Gerard Lacz, Animals Animals   |
| A bald eagle on the lookout for a fish dinner.                                    | Brook trout are prey to bald eagles, bears, and humans.                            |

Farther out in the water, where it is deeper and cooler, [brook trout](#) lurk in the shade of the hemlock tree. They live in the gravelly riverbeds where the water is clear and cool. The brook trout is a major predator of bottom-dwelling invertebrates and land-dwelling insects that fall into the water. [Channel catfish](#) live and feed along the muddy bottoms of ponds and rivers. [Smallmouth bass](#) swim in deeper water, and catch larger prey like frogs and smaller fish. These fish are eaten by still larger animals, like [bald eagles](#) and [black bears](#).



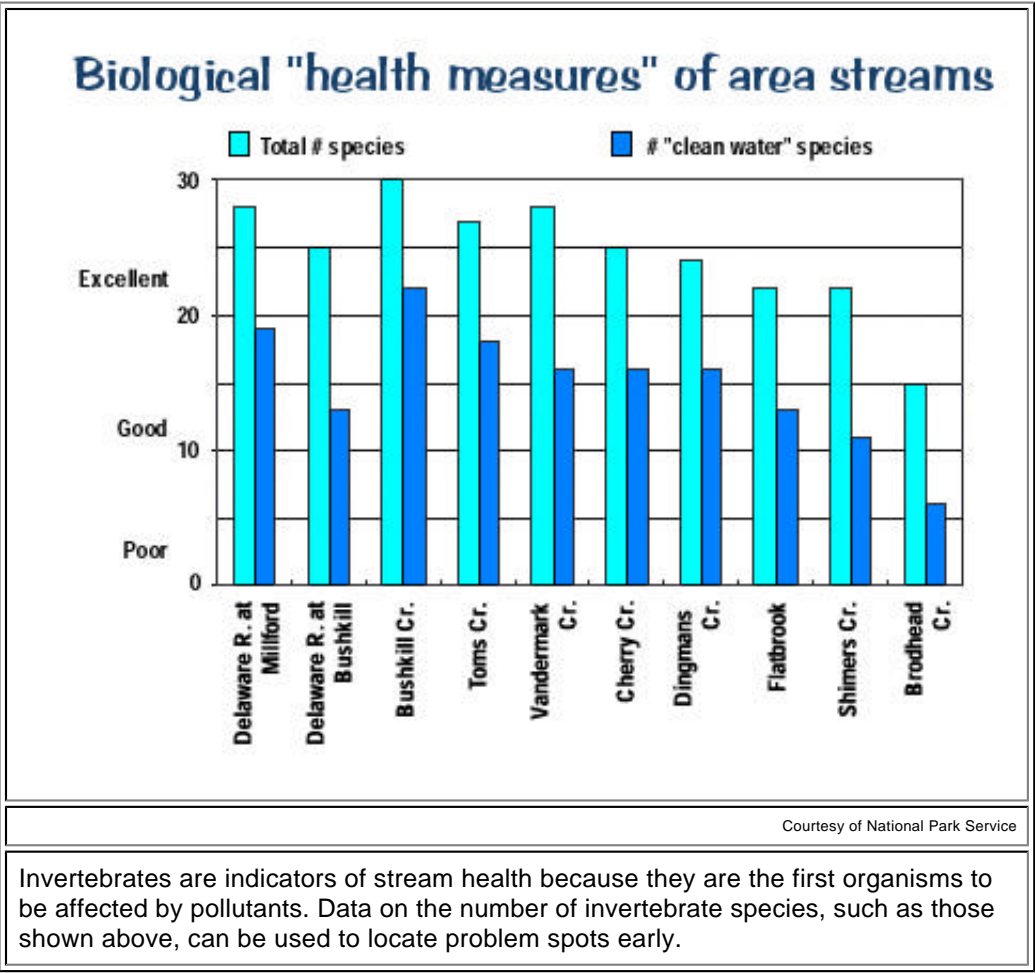
Annual productivity, or the amount of energy provided by the producers in this ecosystem, is intermediate, about 2400 kilocalories/square meter/year of blue-green algae and plant material. The productivity in this ecosystem changes with abiotic conditions such as temperature, depth, and water quality.

ISSUES

Although today the Delaware River is one of the cleanest rivers in the United States, pollution from industry and urbanization has taken its toll on this river since the 1700s. Early settlements along the river dumped raw sewage directly into the water, and thousands of people died every year from waterborne diseases. As industrialization increased in the watershed, it became a polluted disaster area. By the 1940s,chemical factory wastes and untreated human sewage had fouled the river so badly that no fish could survive in its oxygen-depleted waters.

Many efforts were undertaken to clean up the Delaware River, with little impact. In 1962, the Delaware River Basin Comission was created and combined the efforts of New York, New Jersey, Delaware, and Pennsylvania. In 1972, the Commission received \$1 billion in federal grants under the Water Pollution Control Act, and the river began its dramatic comeback.

While the efforts and results of the Delaware River cleanup are a victory for clean waterways, the issue has not gone away. New and unforeseen threats are arising for the Delaware River and many other rivers in North America.



While the water in the Delaware River is clean, the years of industrial pollution have left a legacy in the river bottom. Pollutants such as PCBs, mercury, lead, DDT, and other pesticides remain in river-bottom detritus. Invertebrates, such as scuds and zooplankton, feed on detritus and ingest the pollutants. These pollutants work up the food chain and are concentrated in fish and the fishes predators: bald eagles, black bears, and humans.

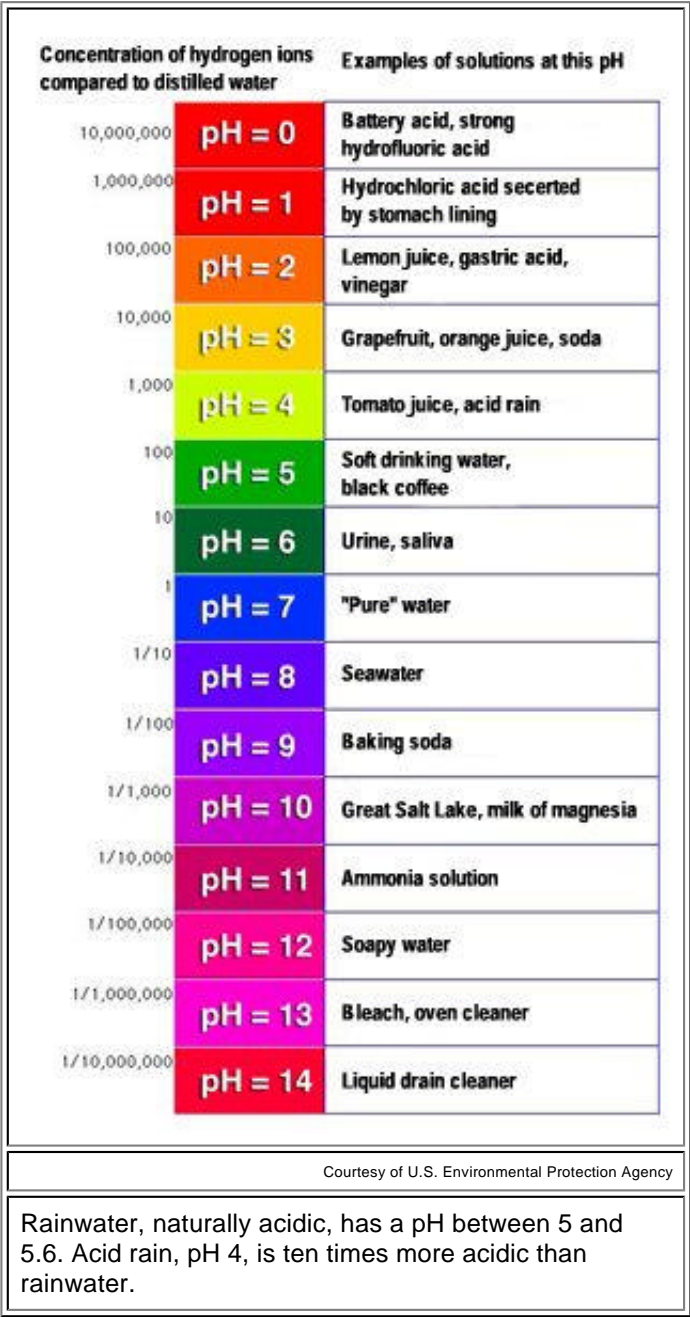
Other threats to the river are ongoing. During storms, pollution from the land in the watershed is washed into the river. This includes herbicides and pesticides, fertilizers, and mine tailings. The most damaging is what is called point-source pollution. These direct discharges come from sewage treatment plants, factories, chemical and power plants, paper mills, and refineries. Increased regulations for industry and agriculture increase the cost for those goods and services to consumers.



The Delaware Water Gap National Recreation Area is in a part of Pennsylvania that experiences acid precipitation. This "acid rain" affects all the watersheds in this part of Pennsylvania.

Acid rain

In the 1960s, people began to notice changes in normally productive lakes. Populations of fish and other aquatic organisms were declining. Trees that bordered lakes and streams were dying. This was happening not only in the United States and Canada, but also in Europe, Asia, and Australia. All of the affected areas were downwind from industrial centers.

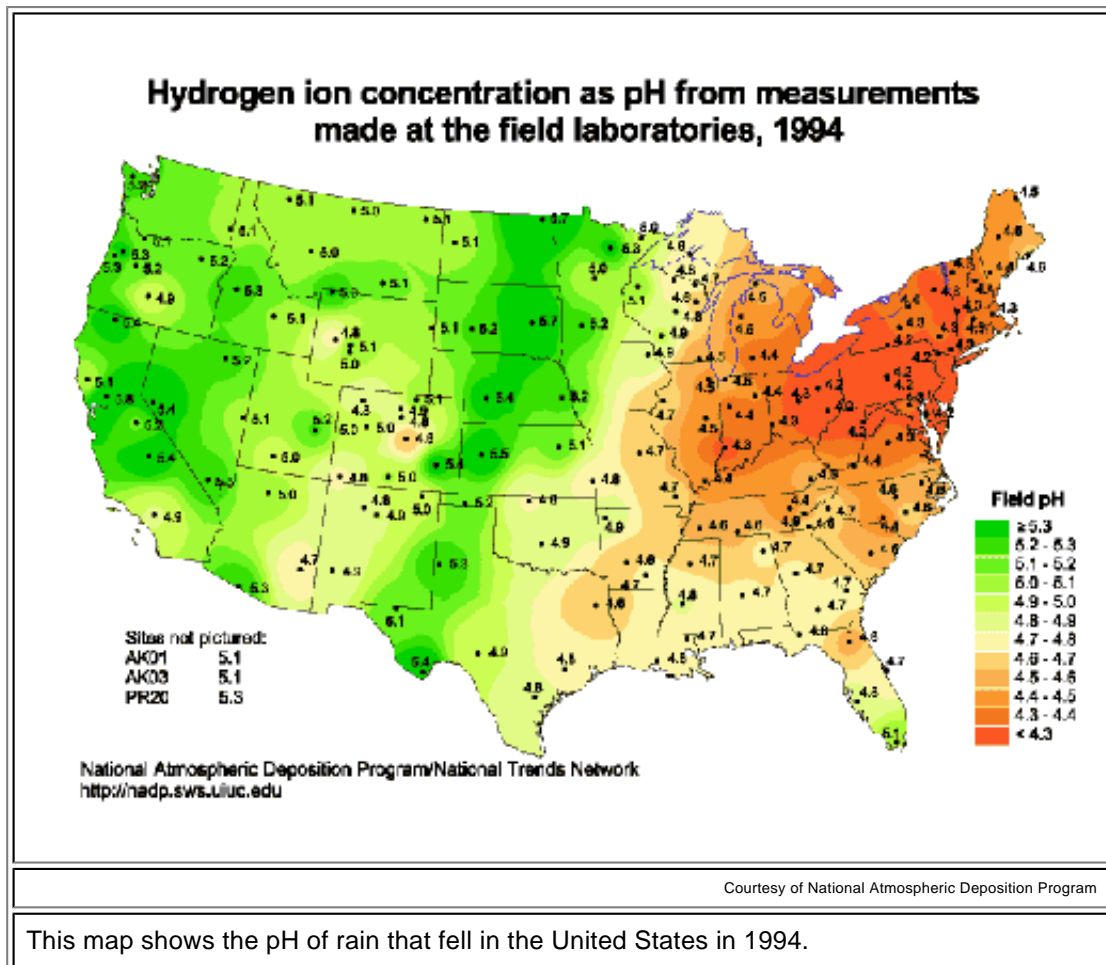


Scientists suggested that pollution from factories and automobiles is poisoning the water in lakes and streams. Factory and automobile pollution frequently contains sulfur dioxide and nitrogen oxide gases. These gases rise into the air, where they dissolve in droplets of atmospheric water to form sulfuric acid and nitric acid. When this acid falls with rain, snow, sleet, hail, or fog, it is called acid precipitation.

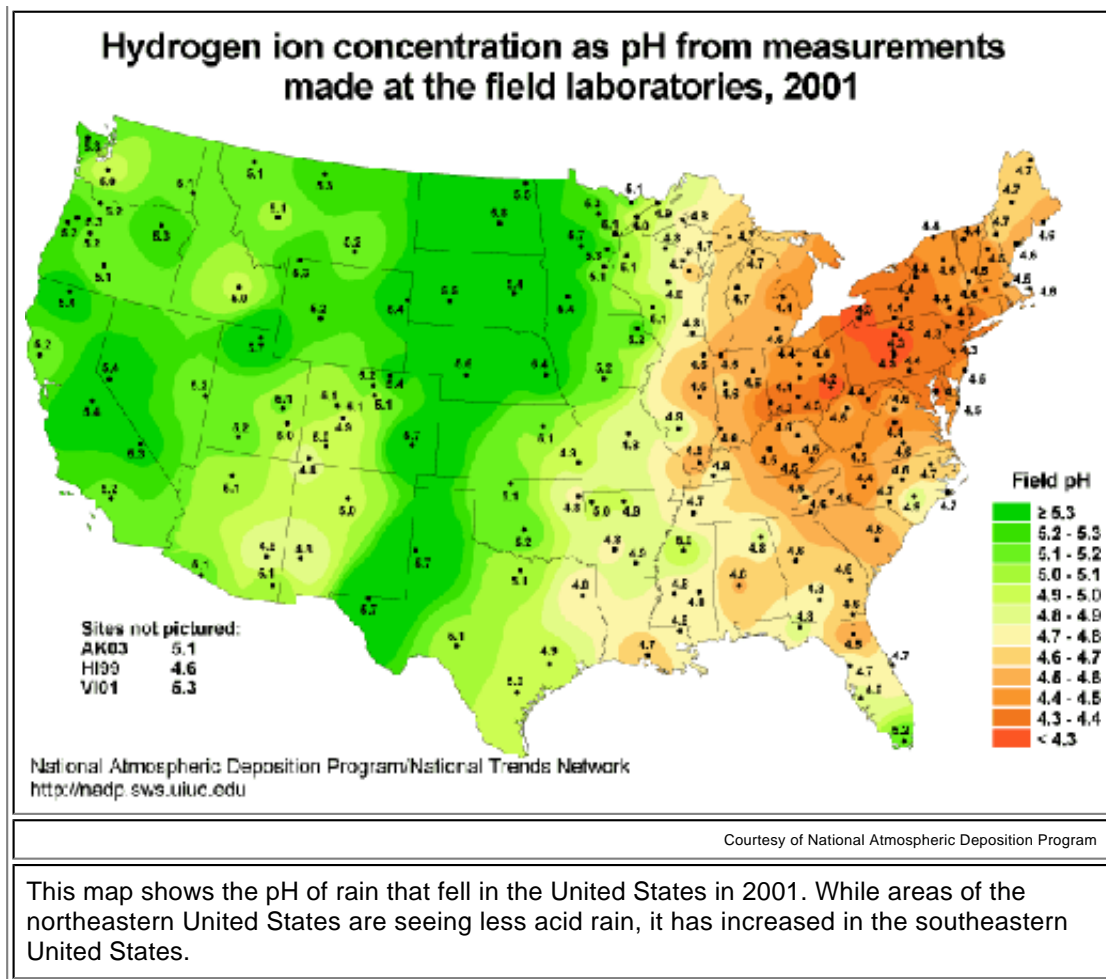
## Why is acid rain such a problem?

An acid is a chemical that in a water solution tastes sour and reacts easily with many other substances. Lemon juice, vinegar, and hydrochloric acid are acids. Lemon juice and vinegar are dilute acids, and hydrochloric acid is strong. Acidity is a measurement of how many charged hydrogen ions are in a solution. This is called pH, and it is measured on a scale of 1 to 14. Solutions with a pH between 1 and 6.9 are acidic, and those between 7.1 and 14 are basic. Liquids with a pH of 7, like pure water, are neutral. There is a tenfold difference between each number on the scale. So a solution with a pH close to 2, like lemon juice, is ten times more acidic than a solution with a pH 3.

Rainwater is naturally a little bit acidic, pH 5–5.6. Normally, rainwater picks up some minerals as it flows through the ground to lakes and streams. The pH of a lake or stream depends in part on what rocks and minerals are in the watershed and the river bottom. Some rocks, like limestone, are basic and neutralize acids. Most healthy lakes and streams have a pH between 7 and 9.2.



Acid precipitation, or acid rain, officially has a pH less than 5.6. However, the pH of acid rain can be as low as that of lemon juice or vinegar. Acid rain may fall directly into a lake or stream, or flow there as runoff from the watershed. If the lake contains limestone bedrock, the acid is neutralized for a while. However, eventually all the neutralizing capacity, or buffer, in the bedrock is used up, and the pH of the lake or stream begins to drop. When it receives acid precipitation, the pH of a lake can drop from 9.2 to below 4.5 in less than 10 years.



Plants and animals can live only within a certain pH range. Aquatic plants grow best between pH 7 and 9.2. As the pH drops to 6.0, crustaceans, insects, and some plankton are negatively affected. When the pH of a lake drops below 5.5, mussels and aquatic snails are affected. Acidic water will even begin dissolving their shells. When the pH drops to 5.0, some frogs and fish have died, and plants that prefer acidic conditions, such as mosses, invade the area. When the pH falls below 4.5, all fish die and the water contains few animals or microorganisms. Acid rain decreases habitat quality, because the ponds are no longer habitable by aquatic animals, and no longer provide food to forest animals that go there to feed.

Acid rain dissolves nutrients and minerals out of the soil and washes them away. Without the proper nutrients, plants cannot grow as vigorously and may become weak. Acid rain also dissolves toxic minerals from the soil. These toxic minerals may accumulate in groundwater or in ponds, further stressing organisms. They may also block a plant's access to important minerals or clog stomata, making gas exchange and photosynthesis difficult. Such conditions also encourage the growth of pests and fungi on plants.

### What has happened in this issue?

In 1990, laws were passed and other programs were started to help reduce acid rain. Due to these measures, sulfur dioxide emissions have dropped. However, the nitrogen oxide levels have not changed. In order to see real recovery, the amount of nitrogen oxide would need to drop, too.

Efforts to keep the Delaware River clean continue. A current project to dredge the lower Delaware to make it deeper has met resistance from the public. They fear that the dredging will stir up more of the old pollutants buried under the mud.

### New power plants

Reliant Power wants to build a power plant just south of Portland, Pennsylvania. This is only a few miles from the Delaware Water Gap. The company already owns two other power plants in this area. The power generated at the new plant would not be used in Pennsylvania, but would be sold to New York and New Jersey. These states have stricter environmental protection measures than Pennsylvania does. Reliant Power's plants in Pennsylvania are currently the worst sources of pollution in the area. Power plants increase the amount of particulate matter in the air and produce nitrogen oxide and sulfur dioxide. They also reduce water levels, create noise pollution, and produce steam that makes foggy and hazy conditions.

## THE DEBATE

Before making decisions that affect an ecosystem, it is important to gather information from a variety of sources. Below are the views of several individuals or groups that have an interest in the future of the Delaware Water Gap National Recreation Area. After each quote the hyperlink goes to the original source of the quote. Refer to these sites for more information.

Use the information provided to decide where you stand on this debate.

### DEBATE: Should there be stricter control of pollution and acid rain sources?

#### People who believe regulations are strict enough

##### *Housing developer*

"If my company plans to build a new housing development we have to pay extra to support a bigger waste treatment plant and nonpoint source pollution. Nonpoint source pollution is pollution they can't determine where it comes from. It's not even pollution because of our development. This is going to make the price of the new homes go even higher."

*U.S. Environmental Protection Agency, Nonpoint Source News-Notes, Notes on Watershed Management, Urban Watershed Bill Introduced, May/June 1994 Issue #36*

"The first prong requires that an applicant for Commission project approval submit and implement nonpoint source pollution control plans for new or increased nonpoint source loads generated in a project's new or expanded service area. For example, if a wastewater treatment plant project of 10,000 gallons per day or greater is proposed to serve a new housing development, a nonpoint source control plan for the housing development serviced by that plant must be implemented. Water supply projects greater than 100,000 gallons per day and selected other types of projects in the drainage area to Special Protection Waters are similarly affected."

<http://www.epa.gov/owow/info/NewsNotes/issue36/nps36wat.html>

##### *Homeowner in Delaware River watershed*

"Our town was built a hundred years ago with an old-fashioned sewage system. They would have to tear up the whole town to replace it with a new one. We're just a small community, we couldn't be adding that much pollution anyway. All the new regulations for factories and new construction should take care of the problem without making us have to pay."

*Delaware Riverkeeper Network, fact sheet, Delaware River*

"Another hazard to the health of the river comes from point-source pollution—direct discharges from municipal and industrial sewage treatment plants, power plants, chemical plants, paper mills, refineries, and refractories. Most point-source dischargers have permits issued under the Clean Water Act and the National Pollution Discharge Elimination System. These permits limit the quantities and types of pollutants permitted to be contained in the wastewater. There are 1600 permitted discharge points in the Delaware Watershed. "

<http://www.delawareriverkeeper.org/factsheets/delaware.html>

##### *Visitor to Delaware Water Gap National Recreation Area*

"I bring my family here so we can have fun. Now they are telling us we can't use our jet skis because they pollute the water. This is a recreation area and this is what we do for recreation."

*Cat Lazaroff, Jet Skis Banned in Most U.S. Parks*

"The National Park Service announced new rules today intended to reduce the impact of personal watercraft use in the National Park system. Still, some environmentalists say the regulations do not go far enough to protect waterways from pollution and damage caused by jet skis and other watercraft."

<http://ens-news.com/ens/mar2000/2000-03-21-06.asp>



**People who believe regulations should be stricter:**

*Division of Research and Resource Planning, 1998 Natural Resources News, Delaware Water Gap National Recreation Area*

"Besides the obvious environmental justification for these extremely stringent regulations, economic benefits are protected as well. Direct economic benefits derived from river recreation in this reach of the Delaware are estimated to exceed \$70 million per year and growing. Benefits include the employment of hundreds of persons in the canoe livery and fishing guide business sectors and thousands in the service/tourism sector."

<http://www.nps.gov/dewa/InDepth/NRnews/natnews1.html>

President Bill Clinton to U.S. Representative Rush Holt (D-NJ)

"As you know, the future of the Delaware River, the longest free-flowing river in the eastern United States, is vital to the economy of the regions surrounding this important waterway. Wild and Scenic River designation will encourage natural and historic resource preservation and protect precious open space. By allowing local municipalities to sustain and protect the Delaware River as one of our nation's national treasures, this law will help to ensure the vitality of these communities and the quality of life of their citizens."

[http://www.state.nj.us/drbc/wild\\_scenic.htm](http://www.state.nj.us/drbc/wild_scenic.htm)

*Sport fisherman on the Delaware River*

"The river water looks very clean, but they tell us we shouldn't eat the fish because they have mercury and PCBs in them. They need to do more to clean up the sediments in the river."

*Study funded by the U.S. Environmental Protection Agency, Regions II & III, and the Delaware River Basin Commission*

"The report indicates that the current fish contamination problem cannot be attributed solely or predominantly to 'historic' sediment contamination already in the estuary, as many resource managers have believed. Indeed, the active loading entering the estuary from sewage treatment plants, combined sewage outflows (CSOs), and tributaries is sufficient, independent of the PCBs already in estuary sediments, to cause water quality criteria exceedances and associated fish contamination."

[http://www.newhopepa.com/DelawareRiver/currentissues\\_2.htm](http://www.newhopepa.com/DelawareRiver/currentissues_2.htm)

**Questions**

- Which side of this debate do you support?
- What scientific evidence supports your position?
- After looking at the evidence, did you change your position? Please explain why.

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**WEB LINKS**

National Park Service, Delaware Water Gap National Recreation Area - <http://www.nps.gov/dewa/>

Cat Lazaroff, *Jet Skis Banned in Most U.S. Parks* - <http://ens-news.com/ens/mar2000/2000-03-21-06.asp>

Courier-Post, *A River's Rebirth* - <http://www.southjerseynews.com/river/>

Delaware River Basin Commission, Home Page - <http://www.state.nj.us/drbc/drbc.htm>

Delaware River Basin Commission, *The Delaware River Basin* - <http://www.state.nj.us/drbc/thedrb.htm>

Delaware Riverkeeper Network, fact sheet, *Carrying Capacity in Delaware Water Gap National Recreation Area* - [http://www.delawareriverkeeper.org/factsheets/carrying\\_capacity.html](http://www.delawareriverkeeper.org/factsheets/carrying_capacity.html)

Delaware Riverkeeper Network, fact sheet, *Delaware River* - <http://www.delawareriverkeeper.org/factsheets/>

[delaware.html](#)

Delaware River, New Hope, Pennsylvania - [http://www.newhopepa.com/DelawareRiver/currentissues\\_2.htm](http://www.newhopepa.com/DelawareRiver/currentissues_2.htm)

Division of Research and Resource Planning, 1998 Natural Resources News, Delaware Water Gap National Recreation Area, - <http://www.nps.gov/dewa/InDepth/NRnews/natnews1.html>

Kathleen Kodish Reeder, National Park Service, *Restoring a Watershed: Applying New Technology to Migrate Acid Mine Drainage in the Northeast* - [http://www2.nature.nps.gov/pubs/yir/yir2000/pages/07\\_new\\_horizons/07\\_02\\_reeder.html](http://www2.nature.nps.gov/pubs/yir/yir2000/pages/07_new_horizons/07_02_reeder.html)

National Atmospheric Deposition Program, isopleth maps - <http://nadp.sws.uiuc.edu/isopleths/>

National Park Service, Delaware Water Gap National Recreation Area, History - <http://www.nps.gov/dewa/InDepth/CRindex.html>

National Park Service, *Executive Summary: Lower Delaware River Management Plan* - <http://www.nps.gov/chal/sp/p07new1.htm>

National Park Service, New Projects at Delaware Water Gap National Recreation Area - <http://www.nps.gov/phso/science/newprojDEWA.htm>

New Jersey's Great Northwestern Skylands, Delaware Water Gap National Recreation Area - <http://www.njskylands.com/pkdwgnra.htm>

President Bill Clinton to U.S. Representative Rush Holt (D-N.J.) - [http://www.state.nj.us/drbc/wild\\_scenic.htm](http://www.state.nj.us/drbc/wild_scenic.htm)

U.S. Environmental Protection Agency, Nonpoint Source News-Notes, *Notes on Watershed Management, Urban Watershed Bill Introduced*, May/June 1994 Issue 36 - <http://www.epa.gov/owow/info/NewsNotes/issue36/nps36wat.html>

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